

## Four novel species of *Sordariomycetes* from Andaman Islands, India

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(Submitted on May 05, 2021; Accepted on June 15, 2021 )

### ABSTRACT

The present study revealed four novel species belonging to *Sordariomycetes*, isolated from decomposing plant litter collected from Andaman Islands, India. These include *Allodiatrypella ananthapadmanabhae*, *Canalisporium koshabeejae*, *Clypeophysalospora longispora* and *Linocarpon acutospora*. All the new species are described based on morphology, supported by recent literature and their distribution in Andaman Islands, India.

**Keywords:** *Ascomycota*, diversity, fungi, novel species, taxonomy.

### INTRODUCTION

More than 30,000 fungi have been reported from India (Manoharachary *et al.*, 2005, Niranjana and Sarma 2020a). The Andaman and Nicobar Islands of India, however, are poorly investigated for fungi. A recent check list published shows that there are only 446 fungi have been reported from Andaman Islands which is less than 2% when compared to mainland India (Niranjana and Sarma, 2018a). Since there are more than 2,250 plant species are known we estimated around 15,000 fungal species to be present in Andaman Islands (Niranjana and Sarma, 2018a) based on Hawksworth's formula of 6 fungal species per host plant (Hawksworth, 1991). Among different classes of *Ascomycetes*, *Sordariomycetes* and *Dothideomycetes* are the most diverse and are represented by a large number of species globally. Several publications have reported latest treatises on the group *Sordariomycetes* (Zhang *et al.*, 2006; Kirk *et al.*, 2008; Pande 2008; Cai *et al.*, 2014; Maharachchikumbura *et al.*, 2015, 2016; Senanayake *et al.*, 2015; Samarakoon *et al.*, 2016; Réblová *et al.*, 2016; Hongsanan *et al.*, 2017; Luo *et al.*, 2019; Hyde *et al.*, 2020a).

From India, Thind and Dargan (1979) and their co-workers have extensively studied the fungi belonging to *Sordariomycetes* and published several new species. They described 125 species belonging to 13 genera of *Xylariaceae* from India. *Sordariomycetes* has been reported from various habitats in India by different workers (Bilgrami 1991, 1997; Karun and Sridhar 2015; Borse *et al.*, 2016; Dargan, 2016; Niranjana and Sarma, 2018b). The studies focused on soil and decaying crops as a source for *Chaetomiaceae* members were contributed by Vaidehi (1973). We have embarked on fungal diversity studies concentrating on *Ascomycota* from Andaman Islands and have described one new family, few new genera and several new species and new records recently (Niranjana and Sarma 2018a, b, c, d, e, 2019, 2020a, b; Hongsanan *et al.*, 2020a, b; Hyde *et al.*, 2020a, b). In the present paper we describe four novel species belonging to *Sordariomycetes* from Andaman Islands, India at morphological level.

### MATERIALS AND METHODS

Dead and decaying plant litter samples were collected from reserve forests in different locations in Andaman Islands.

These samples were then packed into zip-lock plastic bags and they were washed under running tap water and dried in the room. The samples were then transported to the laboratory in the main campus of Pondicherry University in Pondicherry. After incubation of the samples in the plastic moist chambers for a week at room temperature, the samples were examined under a stereozoom microscope (Optika SZM-LED, Italy) for locating the fruit body and slide preparation mounted in water or lactophenol + cotton blue and compound microscope (Olympus CH2i, Japan) is used to take the morphological descriptions (Niranjana and Sarma, 2020b). The photomicrographs were taken using a Nikon ECLIPSE TiU vertical microscope with DIC lenses equipped with Nikon DS-Fi2 digital camera and the measurements were taken using the image analysis software. Photoplates were made with Microsoft power point and Adobe Photoshop version 7.0. The herbarium materials of the holotype were deposited at Ajrekar Mycological Herbarium (AMH), Agharkar Research Institute (ARI), Pune, India. The newly described species are compared with the existing species [www.indexfungorum.org/Names/Names.asp](http://www.indexfungorum.org/Names/Names.asp) and new names were registered with MycoBank.

### Results

#### Taxonomy

1. *Allodiatrypella ananthapadmanabhae* M. Niranjana & V.V. Sarma sp. nov. **Figs.1 a-m**

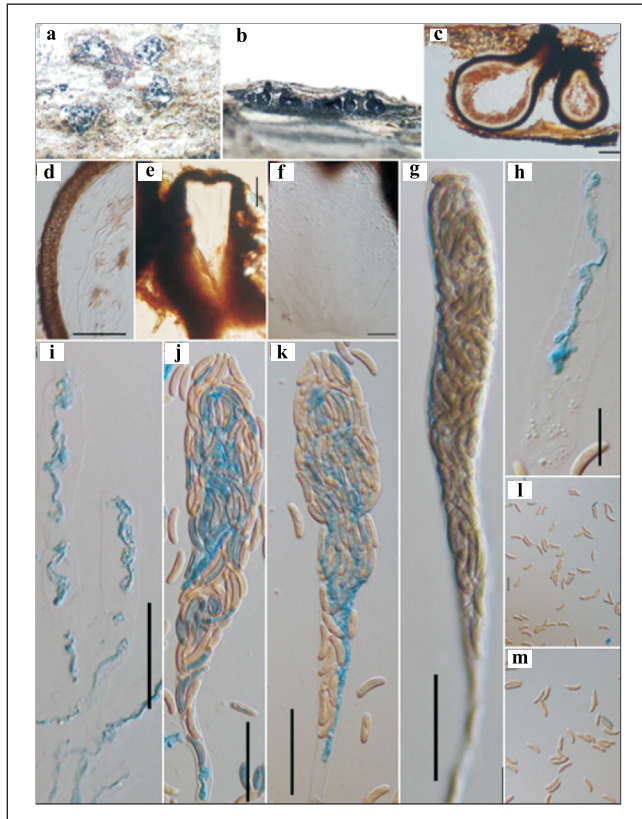
**Index fungorum number:** IF558365;

**Facesoffungi number:** FOF 09816

**Etymology:** In recognition of Dr. Ananthapadmanabhan's contributions to Indian ascomycetous fungal research.

Saprobic on unidentified twig. Teleomorph: Stromata immersed in the bark of deadwood, circular, surface black, 3-10 ascospores per stroma. Ascospores 500-600 × 310-410 μm, including necks, perithecial, globose, clustered, single to grouped, immersed slightly raised, long neck, long furrow, narrow towards down, ostiolate with septate periphyses. Peridium 15 μm wide, bipartite, outer thick cortical layer and inner medullary thin hyaline layer with textura angularis

cells. Hamathecium: paraphyses cellular, numerous, septate with constrictions, guttulate,  $13.9\ \mu\text{m}$ , uneven. Asci  $90\text{-}183 \times 15\text{-}29\ \mu\text{m}$  ( $= 136 \times 22$ ,  $n=25$ ), unitunicate, pyriform to clavate, broad rounded apical apex, with an apical ring J-ve in Lugol's reagent, long pedicellate. Ascospores  $6.2\text{-}12.5 \times 2\text{-}2.5\ \mu\text{m}$  ( $= 8 \times 2.2$ ,  $n=25$ ), multi-spored, sub-hyaline, allantoid, rounded ends, smooth-walled. Anamorph: Undetermined.



**Fig. 1:** *Allodiatrypella ananthapadmanabha* (PUFNI-17439) a Stromata b,c Vertical section c,e Section of Ascomata d Peridium e f Ostiolar neck i Paraphyses g,j,k Asci l, m Ascospores. Scale bars: c= $100\ \mu\text{m}$  d, e= $50\ \mu\text{m}$  f,g,i-k=  $20\ \mu\text{m}$  h,l, m= $10\ \mu\text{m}$

**Material examined:** India, Andaman and Nicobar Islands, North Andaman, Diglipur, Mohanpur ( $12^{\circ}53'29.8''\text{N}$   $92^{\circ}51'28.4''\text{E}$ ). Isolated on unidentified twig, 6 January 2017, M. Niranjan & V.V. Sarma (PUFNI-17439). South Andaman, Ferrargunj ( $11^{\circ}43'15''\text{N}$   $92^{\circ}39'32''\text{E}$ ) on bamboo culms (T302F3) 04 January 2017.

**Remarks:** *Allodiatrypella* Zhu & Fan was raised based on the type species, *A. betulae* with phylogenetic analyses (Zhu *et al.*, 2020). Some of the species belonging to *Diatrypella* have distantly clustered and hence were transferred into the new genus *Allodiatrypella*. This genus is morphologically distinct from *Diatrypella* in having the clavate to elongate, obovoid asci and ascospores that are pale yellowish to pale brown at maturity. Currently, *Allodiatrypella* consists of six species, viz., *A. betulae*, *A. betulicola*, *A. betulina*, *A. hubeiensis*, *A.*

*xinjiangensi* and *A. yunnanensis*. An identification key and complete descriptions of *Allodiatrypella* species have been provided in Zhu *et al.*, (2020), in which all the species have  $6\text{-}9\ \mu\text{m}$  long ascospores, excepting *A. yunnanensis* ( $18\text{-}22 \times 3\text{-}4\ \mu\text{m}$ ). Similarly, the ascomata of *A. betulae*, *A. betulicola*, *A. betulina*, *A. hubeiensis* and *A. xinjiangensi* are larger and have smaller asci when compared to *A. yunnanensis* and *A. ananthapadmanabhae*. The ascomata of *A. ananthapadmanabhae* are larger than *A. yunnanensis* ( $500\text{-}600 \times 310\text{-}410$  vs.  $360\text{-}440 \times 245\text{-}260$ ) whereas the asci ( $90\text{-}183 \times 15\text{-}29$  vs.  $105\text{-}210 \times 15\text{-}30\ \mu\text{m}$ ) and ascospores ( $6.2\text{-}12.5 \times 2\text{-}2.5$  vs.  $18\text{-}22 \times 3\text{-}4\ \mu\text{m}$ ) are smaller. Hence, based on the morphologically distinct characters present taxon is described here as a new species, *A. Ananthapadmanabhae*.

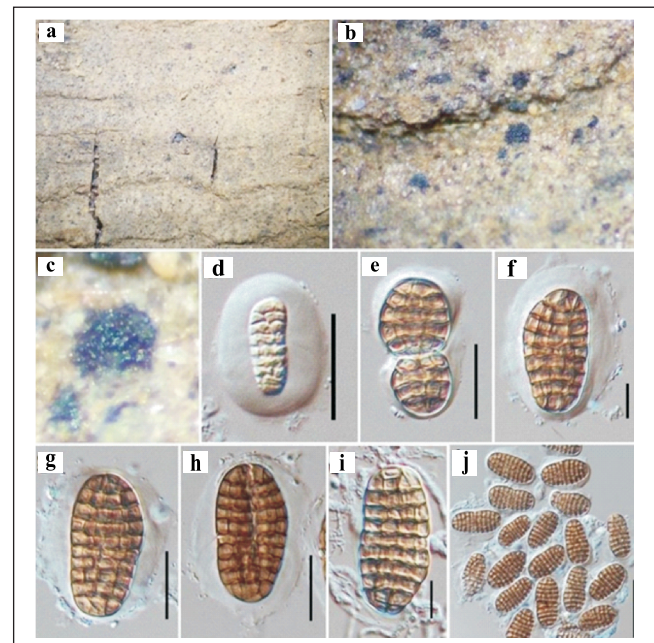
2. *Canalisporium koshabeejae* M. Niranjan & V.V Sarma sp. nov. **Fig. 2 a-j**

**Index fungorum number:** IF558370

**Facesoffungi number:** FOF 09818

**Etymology:** With reference to ascospores containing mucilaginous sheath.

Saprobic on *Caryota mitis*. Anamorph: Superficial, corticolous, circular, dark brown, shining colony, without conidiophore growing on the brown septate mycelium. Conidia  $40\text{-}46 \times 18.5\text{-}21.3\ \mu\text{m}$  ( $= 43.1 \times 20$ ,  $n=25$ ), aggregated, when immature cylindrical, 8 transverse septa and 1-2 longitudinal septa, flattened, pale brown, muriform, 27 cells per conidia, at maturity become cylindrical-ovoid, central constricted, smooth and thick-walled, 9-10 transverse



**Fig. 2:** *Canalisporium koshabeejae* (AMH-10085, Holotype) a-c Anamorph on host d-j Conidiospores. Scale bars: j= $50\ \mu\text{m}$  d, e, g, h= $20\ \mu\text{m}$  f, i= $10\ \mu\text{m}$ .

septa and 3-4 longitudinal septa crossing the 8 cells, dark brown, apex broader than base with tetra angular cells. The number of cells per conidium varies from 34-37, surrounded by thin mucilaginous sheath 7-12.3 (14.4)  $\mu\text{m}$  ( $\bar{x}$  = 9.6,  $n=20$ ), uniform around the conidia. Teleomorph: Undetermined.

**Material examined:** INDIA, Andaman and Nicobar Islands, North Andaman, Diglipur, Mohanpur (13°11'15.0" N 92°53'4.3"E). Recorded on *Caryota mitis*. 17 May, 2018, M. Niranjan & V.V. Sarma (PUFNI 18719). Herbarium submitted in Ajrekar Mycological Herbarium-AMH (AMH-10085) and ex type living culture deposited at National Fungal Culture Collection of India (NFCCI-4510), Pune. Additional materials examined North Andaman, Diglipur, Mohanpur (13°11'14" N 92°53'11"E) on *Caryota mitis* (T214F1, T215F1), 17 May, 2018; Diglipur, on *Endospermum malaccense* (T246F2) 17 May, 2018.

**Remarks:** *Canalisporium* was described by Nawawi and Kuthub (1989), and revised by Goh *et al.*, (1998). It is characterized by muriform conidiospores, and their sexual state is unknown. Presently, this genus contains 17 species described from all over the world (Sri-Indrasutdhi *et al.*, 2010; Zhao *et al.*, 2013; Zhang *et al.*, 2014; Tibpromma *et al.*, 2018; Hyde *et al.*, 2020b) (Table 1). Based on the key (Sri-Indrasutdhi *et al.*, 2010) except *C. panamense* remaining have the conidiophores. *C. koshabeejae* differs from all other existing species of *Canalisporium* in having a distinct thick sheath. Further, *C. koshabeejae* has conidia that are smaller than *C. aquaticium*, *C. caribense*, *C. elegans*, *C. krabiense*, *C. kenyense*, *C. panamense* and *C. pulchrum*. The vertical septa of *C. koshabeejae* (3-4) are similar to *C. aquaticium* (3) whereas the transverse septa (9-10) of *C. koshabeejae* is similar to *C. pulchrum* that has 9 septa. The apical and basal cells of

conidia are also distinctly 1-3 on each pole, which is present only in present species. Therefore, we introduce a new species *C. koshabeejae* in the genus *Canalisporium*.

**3. *Clypeophysalospora longispora*** M. Niranjan & V.V. Sarma sp. nov. **Figs. 3i a-e and Figs. 3ii a-k**

**Index fungorum number:** IF558371

**Facesoffungi number:** FOF 09819

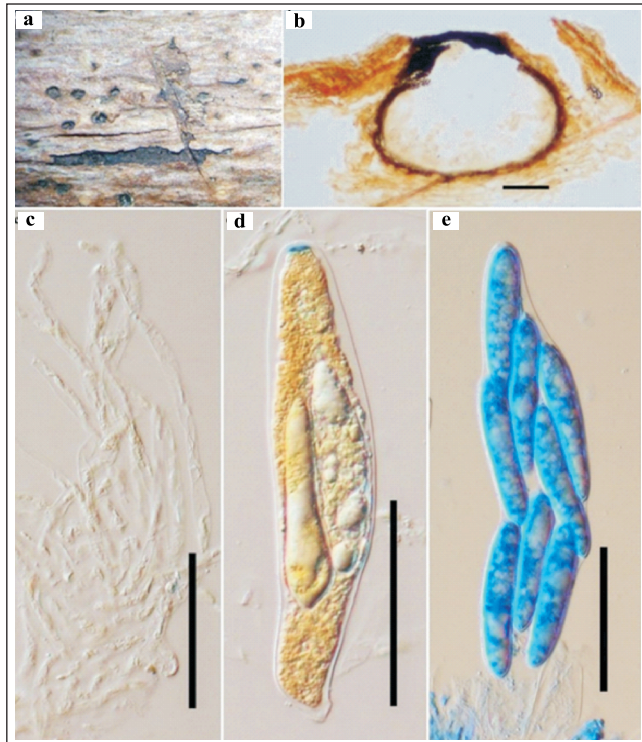
**Etymology-** In reference to long ascospores.

Saprobic on *Terminalia catappa* twig. Teleomorph: Ascomata 320-355 $\times$ 440  $\mu\text{m}$ , immersed, scattered, subglobose, carbonaceous, slightly immersed in the bark, central ostiole with periphyses, clypeate. Peridium 22  $\mu\text{m}$  wide, thick at apex with textura angularis, thin towards lateral and broad region with brown to hyaline. Hamathecium: paraphyses filamentous, anastomosing, with oil globules, aseptate, unbranched. Asci 125-172 (196)  $\times$  35-44  $\mu\text{m}$  ( $\bar{x}$  = 145  $\times$  38.7,  $n=25$ ), unitunicate, 8-spored, fusoid to ovoid, flat apex with thin J+ amyloid apical ring, apedicellate. Ascospores 41-58  $\times$  9-14 ( $\bar{x}$  = 50  $\times$  11,  $n=25$ ), apex overlapping uniseriate, overlapping triseriate in the middle, hyaline, cylindrical when young become obovoid, at maturity, unicellular, asymmetrical, guttulate, aseptate, apically broader, rounded ends, narrow towards basal end, smooth-walled, surrounded by an incipient mucilaginous sheath. Anamorph: Undetermined.

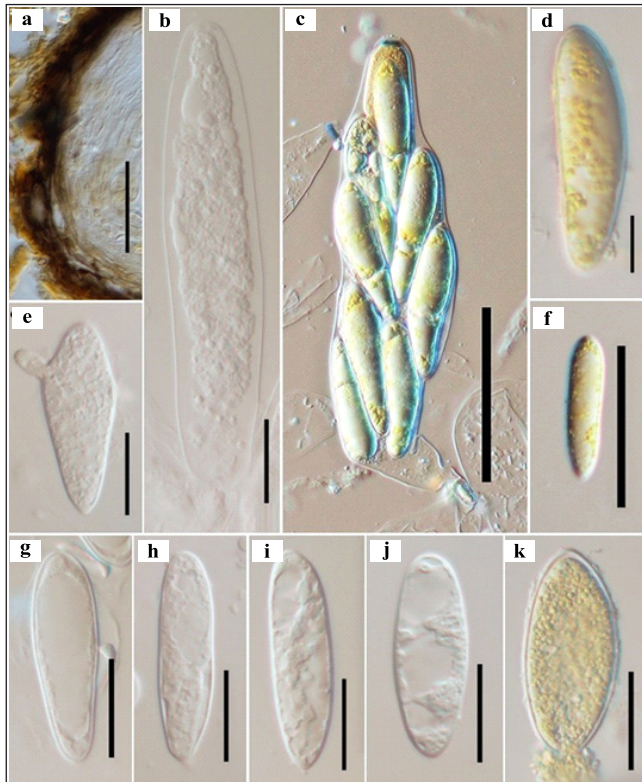
**Material examined:** India, Andaman and Nicobar Islands, South Andaman, Kalatan (11°48'0.9"N 92°42'48.0"E). Recorded on *Terminalia catappa* twig, 19 May 2018, M. Niranjan & V.V. Sarma, (PUFNI-1875), (AMH 10199). Additional material examined South Andaman, Kalatan (11°48'0" N 92°42'48"E) on *Terminalia procera* (T32F1) 19 May 2018.

**Table 1:** A comparison of different characteristics of conidia of *Canalisporium* spp. (Updated from Sri-Indrasutdhi *et al.* 2010) (NA= Not available)

Species	Pigmentation	Length	Width	Lateral thickness	Accentuation of septa	Longitudinal septa	Transverse septa	Apex cells	Base cells
<i>C. aquaticium</i>	Yellow to mid brown	45-58	21-25.5	NA	Yes	3	7-8	1-3	1
<i>C. caribense</i>	Moderate to dark	24-51	15-29	9-12.5	Yes	1	3-6	2	1
<i>C. dehongense</i>	Dark brown	20-30	12-19	NA	Yes	1	3-5	2	1
<i>C. elegans</i>	Moderate	32-58	25-38	10-13	Moderately	4-5	5-8	1-5	1
<i>C. exiguum</i>	Moderate to dark	18-25	13-15	5-8	Yes	1	2-3	2	1
<i>C. grenadoidia</i>	Pale	22-38	16-28	16-22	Moderately	4-6	4-5	1-4	1
<i>C. jinghongensis</i>	Pale	25-33	20-28	7.5-11.5	Moderately	4-5	2-4	1-4	1
<i>C. koshabeejae</i>	Moderate to dark	22-33	18.5-21.3	NA	No	3-4	9-10	1-3	1-3
<i>C. krabiense</i>	Dark	27-50	22-32	NA	Yes	1	4-6	2	1
<i>C. kenyense</i>	Dark	34-56	24-34	14-18	Yes	2	4-5	1	3
<i>C. microsporium</i>	Brown	12.5-20	8-12	4-6	Yes	21	3-6	2	1
<i>C. nigrum</i>	Brown to black	25-34	13-19	6-10	No	1	3-5	2	1
<i>C. pallidum</i>	Pale	25-39	15-20	8-10	No	Mostly 1	4-5	1-2	1
<i>C. panamense</i>	Dark	50-70	46-60	7 up	Moderately	6-8	6-8	-	1
<i>C. pulchrum</i>	Moderate to dark	25-63	20-32	12-17	Yes	2	3-9	1-3	1
<i>C. thailandensis</i>	Dark	22.5-31	17-22	NA	Yes	1	4-5	2	1
<i>C. variabile</i>	Pale	22-35	15-23	10-10.5	No	Mostly 2	2-4	1	1



**Fig. 3i:** *Clypeophysalospora longispora* (AMH 10199) a. Ascomata. b. Section of ascoma. c. Paraphyses d,e. Peridium. Scale bars: b=200  $\mu$ m. c-e=50  $\mu$ m



**Fig. 3ii:** *Clypeophysalospora longispora* (AMH 10199) a. Peridium. b, c. Asci. d-k Ascospores. Scale bars: c=100  $\mu$ m. a, c, f=50  $\mu$ m. e, g-k=20  $\mu$ m. d=10  $\mu$ m

**Remarks:** *Clypeophysalosporaceae* was established by Giraldo *et al.* (2017) which consists of 33 species distributed in 4 genera, *Bagadiella*, *Clypeophysalospora*, *Neophysalospora* and *Plectosphaerella*, of which *Clypeophysalospora* is monotypic genus consists of *C. latitans* produces ellipsoidal spores. The present taxon, *Clypeophysalospora longispora*, has larger ascospores than *Clypeophysalospora latitans*. Although the new taxon has similar ascomatal morphology with *Clypeosphaeria latitans*, it differs in having light yellow ascospores. Therefore, we introduce a new species, *C. longispora*, in the genus *Clypeophysalospora* based on morphological differences.

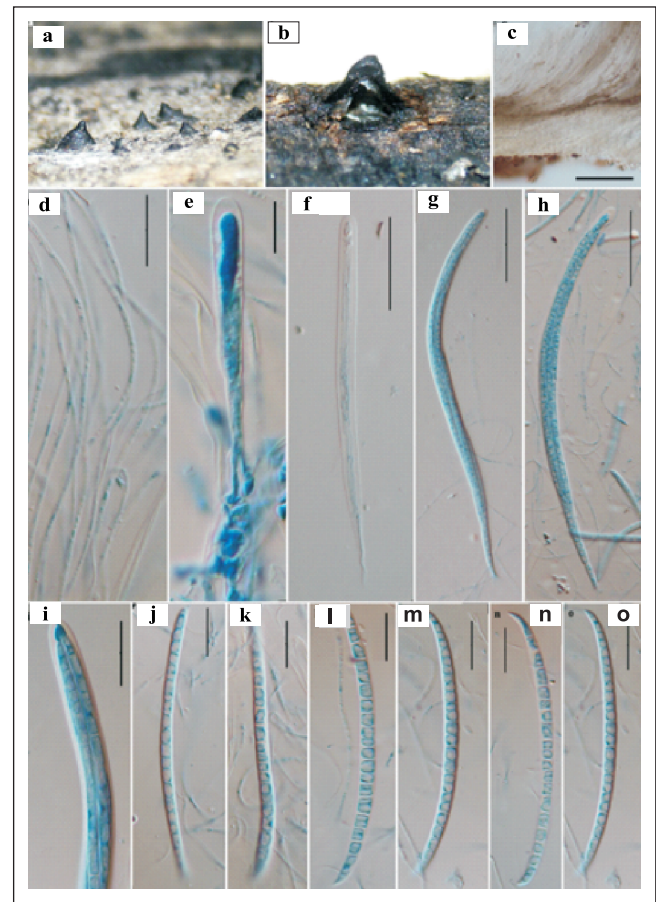
4. *Linocarpon acutospora* M. Niranjan & V.V. Sarma sp. nov. **Fig. 4 a-o.**

**Index fungorum number:** IF558376

**Facesoffungi number:** FOF 09824

**Etymology:** With reference to acute ends of ascospores.

Saprobic on unidentified twig. Teleomorph: Ascomata erumpent, solitary, perithecoïd, black, carbonaceous, thickened, ostiolate, cone shaped to pyramidal, outer rings on necks, short papillate, ostiolate. Hamathecium: paraphyses



**Fig. 4:** *Linocarpon acutospora* (AMH 10200 Holotype) a, b Ascomata c Hamathecium d Paraphyses e-l Asci j-o Ascospores. Scale bars: c, f-h=50  $\mu$ m d, i-o= 20  $\mu$ m e= 10  $\mu$ m

long, thin, septate. Asci 240-290 × 10-14.5 µm ( = 256 × 12.5, n=10), unitunicate, 8-spored, cylindrical, short pedicellate, rounded ends. Ascospores 105-125 × 5-7.5 µm ( = 113.6 × 6.3, n=25), multiseriate, hyaline, filiform, 18-20 septa, without constrictions, straight or slightly curved, sharp acute ends, smooth walled. Anamorph: Undetermined.

**Material examined:** India, Andaman and Nicobar Islands, South Andaman, Chidiya Tapu Reserve Forest, (11°29'24.4"N 92°42'40.1"E). Recorded on unidentified twig, 11 August 2016, M. Niranjana & V.V. Sarma (PUFNI-16333), (AMH 10200).

**Remarks:** *Linocarpon* was introduced by Sydow and Sydow (1917). Monographic accounts on this genus were published by Hyde (1992, 1997). In a recent study, Konta *et al.* (2017) introduced a new family *Linocarpaceae* consisting of two genera *Linocarpon* Syd. & P. Syd. and *Neolinocarpon* K.D. Hyde (Wijayawardane *et al.*, 2018). *Linocarpon* species have ascomata on the surface of the host that form blistered, black, dome-shaped areas, with a central ostioles. The asci are unitunicate, cylindrical with a small non-amyloid apical ring and ascospores are filiform and aseptate (Fröhlich and Hyde 2000; Poonytha *et al.*, 2000). However, *Linocarpon acutospora* differs from existing species by having acute ends of ascospores, two ends curved into one side. Based on the above mentioned morphological characteristic features the present taxon is described here as a new species, *Linocarpon acutospora*.

## DISCUSSION

We have surveyed the diversity of *Ascomycetes* colonizing the dead and decomposing plant twigs fallen on the forest floor in the Andaman Islands, India between 2015 and 2018. Our studies have resulted in several new genera and new species in addition to a new family already published elsewhere (Niranjana and Sarma, 2018 a, b, c, d, e, 2019, 2020 a, b; Hongsanan *et al.*, 2020a; Hyde *et al.*, 2020a,b). In this paper we have described four new species belonging to the class *Sordariomycetes*. Earlier, we have already described more than 20 new species. In a check-list compiled by us on fungi from Andaman Islands we found more than 460 being recorded up to 2018 (Niranjana and Sarma, 2018a). This is a very low number when compared to the around 30000 species recovered from mainland India. But the fact that subsequently several new species have been published shows that the region is very rich for novel fungal species and many more missing fungi are yet to be described.

## ACKNOWLEDGEMENTS

V. Venkateswara Sarma would like to thank the SERB, Ministry of Science and Technology, Government of India, for funding a project (SERB/SB/SO/PS/18/2014 dt. 19.5. 2015). Forest department of Andaman and Nicobar Islands, India is thanked for providing permission to collect samples. The Department of Biotechnology, Pondicherry University is

thanked for providing the facilities. UGC-SAP and DST-FIST programs of Govt. of India in the department are thanked for the infrastructural support. M. Niranjana thanks SERB & DBT Govt. of India for provided fellowship. Niranjana also thanks Prof.R.K. Singh, Department of Botany, Rajiv Gandhi University, Rono Hills, Doimukh, Itanagar, Arunachal Pradesh for encouragement.

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